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February 25, 1975

Dr. Walter E. Jackson
Director of Environmental Control - West
U.S. Steel Corporation
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STS Job No. 17530-C

Reference: Results of Sampling and Analyses of Bottom Samples from the U.S. Steel Gary Works Plant, Gary, Indiana

Gentlemen:

This is a letter report in which we are presenting the results of our investigation of the bottom materials in the vessel slip at your plant in Gary, Indiana. This investigation included sampling the bottom materials at three (3) locations, examination of the recovered samples, and analyses which were predominantly chemical in nature. The samples were obtained on February 4, 1975.

In addition to discussing the sampling operations at the site, this report includes: (1) A Location Diagram, (2) Boring and Sampling Logs, (3) Results from the Chemical Analyses of the Bottom Samples and the Methods Used, and (4) Results from Special Settleability Tests.

1 Sampling Locations

The enclosed Location Diagram, Figure 1, shows the sampling locations and the sample reference numbers. Two sampling locations were within the slip itself; the third location was in the harbor outside the slip.

2 Sampling Observations

2.1 Water Depths

Water depths were measured using a weighted steel tape and are shown on the boring logs. The bottom was found to range between 18 and 31 ft. below the water surface as it existed at the time of sampling. It should be noted that at the time of sampling the lake level was reported by U.S. Steel, Gary, to be approximately 3.1 ft. above the Gary Works Low Water Datum. Air temperatures were observed to be around 36°F; water temperature near the surface was similar.

2.2 Bottom Materials

At the three (3) sampling locations the bottom materials were found to consist of fine to very fine sand. These sands varied from light grayish brown to dark brownish gray. As described on the boring logs,

shells, shell fragments, gravel, partially decomposed wood, as well as coal or slag, and some fibrous debris were found with the sand. Some stratification and localized concentrations of these materials were found in all samples.

Further information concerning depths of interfaces between the different materials and the types of materials found are given on the boring and sampling logs.

3 Bottom Sampling Procedures

Bottom sampling was performed with a truck-mounted, rotary drilling rig which was mounted on a spud barge. The spud barge was attended at all times by a tug boat. The procedures and sampling methods utilized are discussed below. The object of the bottom sampling program was to recover a continuous sample from the top of the bottom materials to the depth of the dredging. Two of the three sampling locations were in the slip, one near the turn basin at the south end of the slip and the other nearer the center of the north-south length of the slip. The third sampling location was in the harbor area east of the entrance to the slip.

On Tuesday, February 4, 1975, sampling was first carried out in the harbor area. The depth of water at this location (L-3) was 17 ft. 10 in. A 3 in. X 10 ft. shelby tube was advanced approximately 10 ft. into the bottom. Seventy percent (70%) of this 10 ft. core was recovered. (The bottom 3 ft. of core slipped out of the tube during raising to the barge.)

The sampling at the south end of the slip (L-1) was then performed. Three samples were recovered at this location. A 3 in. X 5 ft. shelby tube was advanced 5 ft. through the bottom materials with a resulting 2 ft. recovery. The barge was then moved as noted on the boring logs, and another 3 in. X 5 ft. shelby tube was advanced 5 ft. through the bottom materials. Two and one-half (2-1/2) ft. of sample was recovered. A third sample was obtained using a 3 in. O.D. split-spoon. Full recovery was obtained with the split-spoon.

At location L-2, three samples were recovered. The first sample was obtained using a 3 in. X 10 ft. shelby tube. As this tube was brought to the surface, portions of its contents were seen escaping from the bottom of the tube. A 1 ft. portion was retained in a sample jar. A 3 ft. section remained in the sampling tube; the lower 6 ft. portion was lost. The second sample was obtained using a 3 in. O.D. split-spoon. This sample was partially washed out during the recovery operations. The third sample was obtained using a 3 in. X 10 ft. shelby tube; This tube was advanced 10 ft. and recovery was 5 ft.

4 Sample Preservation

The samples recovered were transported to the laboratory in two ways. The materials recovered by the split-spoon were removed from the sampler at the site, placed on a polyethylene sheet, and then placed in specially cleaned sample jars. The materials recovered in the shelby tubes were retained within the tubes; end caps were placed on each tube and taped. All samples were allowed to remain exposed to the 30+°F outside temperature for preservation until examination was made in the laboratory on the following day.

5 Classification and Compositing

On Wednesday, February 5, 1975, the samples were examined in the laboratory, classifying, photographing, and compositing being done. Samples within the shelby tubes were extruded onto clean polyethylene sheets as a continuous core. As would be expected, slight variations existed between the separate shelby tube samples recovered at each given location. These variations included: differences in elevation of several inches in either direction of the various interfaces, and differences in concentration in the minor constituents in each of the various strata.

The strata lengths shown on the sampling logs are averages of the lengths found in the separate shelby tube samples. The minor constituents were primarily shells, gravel, decayed wood, and fibers.

5.1 Compositing

Those portions of the samples which were in a depth zone to be dredged were included in the preparation of composite samples. The outer 1/8 to 1/4 inch of the shelby tube samples was removed due to iron oxide staining, apparently from the sampling tubes. This stained material was discarded and the remainder was placed in specially prepared sample jars. The contents of the jars from each location were sieved through a No. 12 mesh stainless steel sieve (as recommended by EPA, 1969; see Table 2). A new composited sample was then prepared by mixing portions selected from different locations in the jars.

5.2 Observations During Classification

Each of the extruded samples was visually examined and classified. Observations were recorded of the major constituents, the grain size, and minor constituents. In addition, examination was made for the presence of life forms or evidence of life forms.

Two shelby tube samples from location L-1 were extruded in the laboratory. Both samples had fine to very fine sand as the predominant constituent. The upper 10 in. of both samples had traces of silt, fine gravel, small white shells, decomposed wood and individual black particles. The black

particles noted appeared to be either cinders, slag or possibly coal, and were in the medium to coarse sand particle size. In the upper layer of both samples the color was brownish dark gray changing to dark gray. Beneath this upper layer the remainder of the samples showed occasional clusters of shells and voids which could possibly be gas pockets or animal holes. The color within the bottom portion of the sample changed from medium gray to greenish gray, with dark horizontal stratification lines. All of the material recovered within the shelby tubes at location L-1 was used for preparation of the composite sample, along with material from the split-spoon.

Two long shelby tube samples were obtained from location L-2. As with the material obtained at location L-1, the predominant constituent of the samples was fine to very fine sand. Trace constituents included silt, roots, fibers, decayed wood, shells and shell fragments. In the bottom portion of this layer, small gas deposits or voids were noted. The color varied from a dark brownish gray in the upper portion to a light gray at the bottom of this upper layer. The bottom of these samples consisted of a fine light gray sand with traces of silt and shell fragments.

The composite sample for the chemical analysis was made from the upper 3 ft. recovered from the shelby tubes. The material recovered in the split-spoon was not included in the compositing. The outer 1/8 to 1/4 inch of the extruded tube samples were removed to reduce the possibility of contamination from the tube.

A single, long shelby tube sample was obtained from location L-3. This sample was obtained in the harbor area and showed more pronounced stratifications than did the samples recovered in the slip. The upper 53 in. of this sample consisted of fine sand with a trace of shell fragments and black, sand-size particles. The number of shell fragments tended to increase with depth. Horizontal stratification lines 1/4 to 1/2 inch in thickness were observed; color changes from light grayish brown to brownish gray were found. Below this thick layer of sand, a layer, 11 inches in thickness, consisting of sandy, fibrous debris with shells and shell fragments was observed. This layer was then followed by a fine light to dark gray sand containing shells and shell fragments. Dark gray stratification lines were noted. The top 3 ft. of the sample was composited for chemical testing after removal of the outer 1/8 to 1/4 inch of the surface materials.

All samples retained for chemical analyses were then placed under refrigeration prior to sieving and compositing.

6 Special Settleability Testing of Bottom Samples

In order to partially evaluate the rate at which re-suspended bottom materials would settle out, the following procedure was carried out. This procedure was, of course, an approximation to the operations expected in the planned, settling basin for the dredge water slurry.

A composite bottom sample was prepared containing approximately equal amounts of dry solids from each of the three bottom samples. The compositing was done with the wet samples in order to avoid changes that might influence settling rates. After this composited bottom sample was mixed, a portion containing approximately 75 grams of dry material was removed and transferred into a one-liter, glass, graduated cylinder (60 mm I.D.). Deionized water was then added to bring the total volume to 1 liter. This mixture was thoroughly agitated until a uniform suspension was obtained; it was then set aside to allow settling to occur.

After 75 hours, the upper 1/2-liter of the suspension was carefully pipetted off, and a determination made of the total solids present in the portion removed. The amount was found to be 0.11% of the total weight of dry solids originally introduced into the graduated cylinder; this meant that 0.22% of the initial weight of dry solids in the upper 1/2-liter remained after 3 days or that 99.78% had settled out in that period. The upper 1/2-liter was contained in a cylindrical volume extending down from the water surface to a depth of about 6.8 in. (~17cm.).

The above procedure utilized deionized water as the suspending agent rather than water samples from the slips or harbor. As a consequence, the ionic content was considerably less than would be the case of actual dredging operations; for example, Lake Michigan water has an electrical conductivity of 270-280 micromho/cm (25°C.). Generally, higher ionic contents in water produce faster sedimentation rates because of their greater ability to induce coagulation of the finer suspended particles. Thus, it might be anticipated that higher rates of settling than found in the above laboratory test will be found in the actual dredging operations.

If you have any questions concerning this report, please do not hesitate to contact us.

Yours truly,

SOIL TESTING SERVICES, INC.

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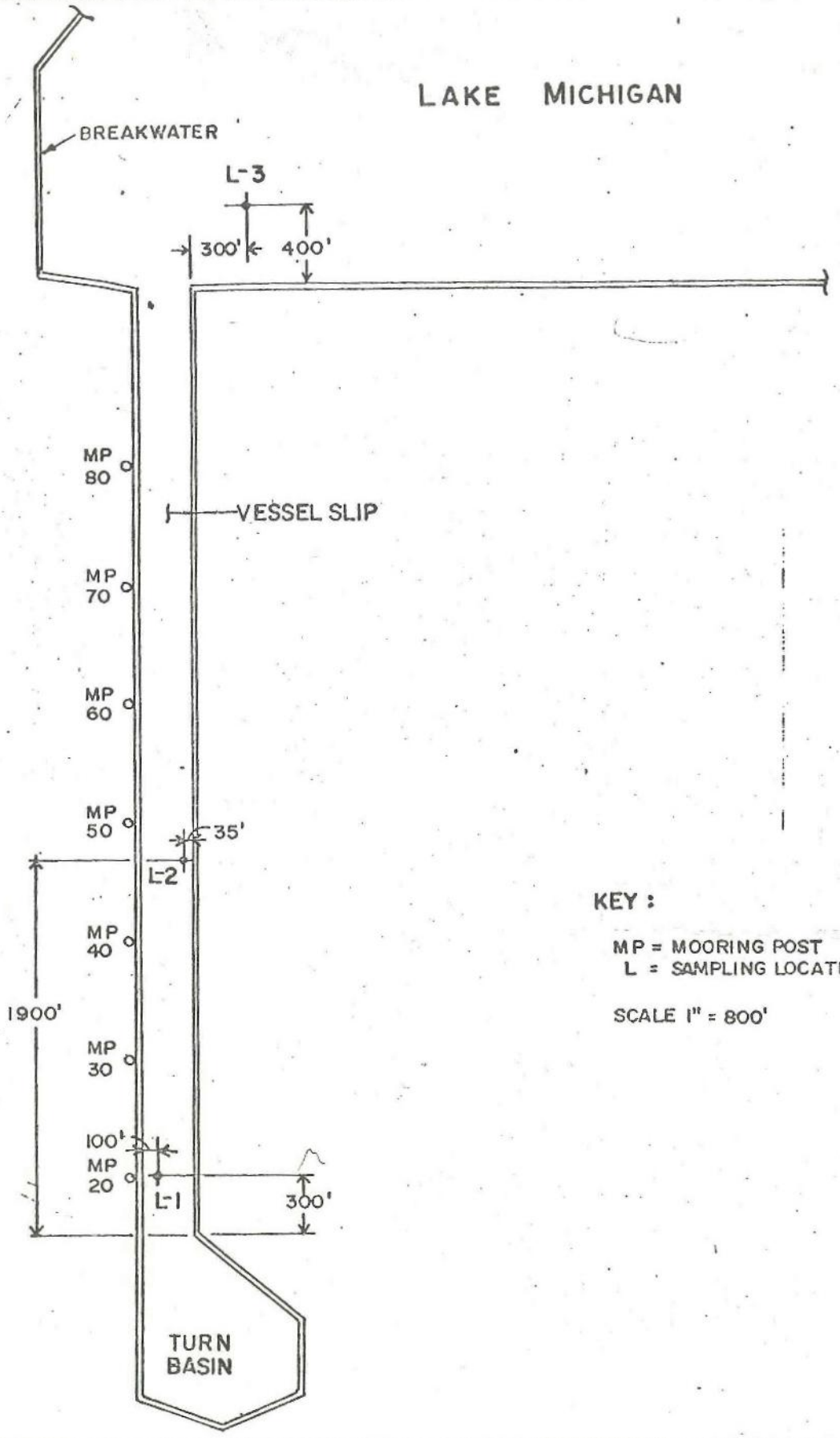
REZ/mf
encl.

FIGURE 1.



BOTTOM SAMPLES LOCATION DIAGRAM
VESSEL SLIP & HARBOR AREA
U.S. STEEL CORP.-GARY WORKS
GARY INDIANA

SOIL TESTING SERVICES, INC.
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS 60062

MP	REZ	FEB., 1975	17530-C

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TABLE 1

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February 20, 1975

Chemical Analyses of Bottom Samples[1]
Taken on February 4, 1975

United States Steel Corporation

	L-1	L-2	L-3
1. Arsenic, mg/kg dry wt.	1.3	1.4	0.6
2. Barium, mg/kg dry wt.	9.5	8.0	4.1
3. Cadmium, mg/kg dry wt.	0.93	0.75	0.46
4. Cyanide, mg/kg dry wt.	0.30	3.68	5.02
5. Fluoride, mg/kg dry wt.	120	85	45
6. Iron, mg/kg dry wt.	26,600	31,300	6,600
7. Lead, mg/kg dry wt.	15.5	16.6	6.1
8. Mercury, mg/kg dry wt.	0.019	0.032	0.007
9. Nitrogen, Total Kjeldahl, mg N/kg dry wt.	240	374	63
10. Oil and Grease, mg/kg dry wt.	392	307	94
11. Oxygen Demand, Chemical mgO_2/g dry wt.	17.9	28.7	2.6
12. Phenols, mg Phenol/kg dry wt.	0.045	< 0.012	~ 0.012
13. Phosphorus, Total, mgP/kg dry wt.	153	138	68
14. Selenium, mg/kg dry wt.	< 0.006	0.012	< 0.006
15. Silver, mg/kg dry wt.	0.68	0.47	0.54
16. Solids, Total Dry (105°C.) % ref. to wet wt.	78.28	80.14	82.22
17. Solids, Volatile (550°C.) % ref. to dry wt.	1.60	2.42	0.40
18. Zinc, mg/kg dry wt.	49	60	32

(1) See Table 2 for Methods of Analyses.

< Means less than. Value indicates lower limit of detectability for the method used.

Methods of Analyses of Bottom Samples
Taken on February 4, 1975

United States Steel Corporation

	Parameter	Method	Preservation	Reference[1]
1.	Arsenic	Fuming Sulfuric Acid Reflux; Atomic Absorption on Arsine Gas Generated by Borohydride Reduction	Refrigeration	104; AA Newsletter[2]; 1973-4
2.	Barium	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	105, 129, 129A, 211, 211(1)A
3.	Cadmium	Fuming Sulfuric Acid Reflux; Atomic Absorption	Refrigeration	109, 109A, 129, 129A, 211, 211(1)A
4.	Cyanide	Titration with Ag^+ after Sulfide Removal and after Acidic Distillation with and without Catalyst (CuCl) and Colorimetrically	Refrigeration	120, 207, 207A, 207B, ASTM D-2036-72[3]
5.	Fluorine	Distillation from Slurry with Sulfuric Acid; Ion Sensitive Electrode	Refrigeration	121, 121A, 121B, 208
6.	Iron	Ashed, Acid-Digested, Colorimetric with O-Phenanthroline	Refrigeration	124, 124A, EPA, 1969[4]
7.	Lead	Fuming Sulfuric Acid Reflux; Atomic Absorption	Refrigeration	125, 125B, 129, 129A, 211, 211(1)A
8.	Mercury	Flameless Atomic Absorption after Fuming Sulfuric Acid Reflux and H_2O_2 De-Colorization and Filtration	Refrigeration	EPA, 1974[5]
9.	Nitrogen, Total Kjeldahl	Digestion with Sulfuric Acid, Mercuric Sulfate and Na_2SO_4 followed by Distillation and Titration of NH_3	Refrigeration	132, 135, 212, 215, 216
10.	Oil and Grease	Soxhlet Extraction using Freon TF	Refrigeration	209, 209A, 209C

Methods of Analyses of Bottom Samples
Taken on February 4, 1975

United States Steel Corporation

	Parameter	Method	Preservation	Reference[1]
11.	Oxygen Demand, Chemical	Reflux with Chromic Acid and Catalysts and Titrate	Refrigeration	142, 200B, 220
12.	Phenols	4-Aminoantipyrine Color Development with $CHCl_3$ Extraction following Acidic Distillation	Refrigeration	222, 222A, 222B, 222C, EPA, 1969[4]
13.	Phosphorus, Total	Acidic Persulfate Digestion @ 15 psi ga. followed by Phosphomolybdate Blue Formation in Isobutyl Alcohol using $SnCl_2$	Refrigeration	223, 223CIII, ASA, 73-4.3[6]
14.	Selenium	Fuming Sulfuric Acid Reflux; Atomic Absorption on H_2Se Gas Generated by Borohydride Reduction	Refrigeration	150; AA Newsletter[2], 1973-4
15.	Silver	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	129, 129A, 152, 211, 211(1)A
16.	Solids, Total Dry	Dried to Constant Weight at 105°C.	Refrigeration	148, 224, 224A
17.	Solids, Volatile	Heat Dried Sample in Muffle Furnace at 550°C. for 1 hour	Refrigeration	224, 224G
18.	Zinc	Ashed, Acid-Digested, Atomic Absorption	Refrigeration	165, 165A, 129, 129A, 211, 211(1)A

(1) Indicates a Section in Standard Methods for the Examination of Water and Wastewater, Thirteenth Edition, 1971; APHA, AWWA, WPCF; Publication Office: American Public Health Association, 1015-18th Street, N.W., Washington, D.C. 20036, unless otherwise indicated.

(2) Atomic Absorption Newsletter.

(3) American Society for Testing and Materials.

(4) Indicates a Section in Chemistry Laboratory Manual Bottom Sediments, Compiled by Great Lakes Region, Committee on Analytical Methods, Published by EPA, Federal Water Quality Administration, Dec., 1969.

(5) Methods for Chemical Analysis of Water and Wastes, 1974, U.S. EPA.

(6) Indicates a Section in Methods of Soil Analysis, Part 2, American Society of Agronomy, 1965.

BORING LOG

STS Job No. 17530-C

Sampling Point No. L-1
Date of Sampling: Feb. 4, 1975

U.S. Steel Corporation
Bottom Sampling - Slip and Harbor Area
Gary Works, Gary, Indiana

Sampling Location: 100 ft.± East of West Wall
Midway Between West Wall Moorings #20 & 21
(300 ft.± North of Entrance of Turn Around)

DESCRIPTION OF MATERIAL

0'-30'6" - Water

30'6"-31'4" - Fine to very fine sand, trace silt, fine gravel, small white shells, decomposed wood and individual black particles - occasional voids and gas pockets 1/8" in diameter from 31'0" to 31'4" - brownish dark gray changing to dark gray - loose - saturated.

31'4"-32'4" - Fine sand, trace decayed wood, shells and shell fragments - shells sometimes occurring in clusters - occasional voids and gas pockets 1/8" diameter - 1/8" to 1/4" horizontal stratification lines - medium gray with color variation in individual particles - medium dense - saturated.

32'4"-33'0" - Fine to very fine sand, trace shells and shell fragments - 1/8" to 1/4" stratification lines - greenish gray - medium dense - saturated.

End of Boring

NOTES:

Three samples were obtained. The location of the first sample is given above. At this location a 3" x 5' shelby tube was used with a resulting 2' of recovery. For the second sample the barge was moved 5' west. A 3" x 5' shelby tube was driven and 50% recovery was obtained. For the third sample, at this location, the barge was moved 45 ft.± west from the location of sample one. A 3" diameter (O.D.) x 2' long split-spoon was utilized to obtain sample. Recovery was 100%.

All recovered material was composited for chemical testing, after removal of the outer 1/8"-1/4" layer.

Water depths were 30'6", 30'6", and 27'10" respectively for the three samples.

BORING LOG

STS Job No. 17530-C

Sampling Point No. L-2
Date of Sampling: Feb. 4, 1975

U.S. Steel Corporation
Bottom Sampling - Slip and Harbor Area
Gary Works, Gary, Indiana

Sampling Location: Opposite West Wall Mooring #47
(1900 ft.± North of Turn Around Entrance,
35 ft.± West of East Wall)

DESCRIPTION OF MATERIAL

0"-29'6" - Water

29'6"-31'0" - Fine sand, trace silt, roots, fibers, decayed wood, shells and shell fragments - coarse sand sized coal, slag, or cinder fragments - dark brownish gray - loose - saturated.

31'0"-32'4" - Fine sand, with 1/2" layers of medium sand, 1/4" clay layer at 31'1", trace silt, decayed wood, shells, shell fragments - small, gravel-sized coal or cinder fragments - 1/8" to 1/4" voids and gas pockets at 31'6" - light gray - medium dense - saturated.

32'4"-34'10"- Fine sand, trace silt, shells and shell fragments - light gray - medium dense - saturated,

End of Boring

NOTES:

Three samples were obtained. The location of the first sample is given above. A 3 in. x 10 ft. shelby tube was used and 40% recovery was obtained. For the second sample the barge was moved 3 ft. west. At this location a 3 in. dia. (O.D.) 2 ft. long split-spoon was used. The sample was partially washed out during recovery. The third sample was obtained at a point 25 ft. west of the first sample. A 3 in. x 10 ft. shelby tube was used and 50% recovery was obtained.

The composite sample for chemical testing was made from the upper 3 ft. of samples 1 and 3, after the 1/8" to 1/4" surface layer was removed.

Water depths were 29'6" at all three locations.

BORING LOG

STS Job No. 17530-C

Sampling Point No. L-3
Date of Sampling: Feb. 4, 1975

U.S. Steel Corporation
Bottom Sampling - Slip and Harbor Area
Gary Works, Gary, Indiana

Sampling Location: 300' East of Northeast corner of slip
400' North of seawall

DESCRIPTION OF MATERIAL

0'-17'10" - Water

17'10"-22'3" - Fine sand, trace white shell fragments and individual black particles - shell fragments increasing with depth, light grayish brown changing to brownish gray, occasional dark gray streaks 1/4" to 1/2" horizontal to inclined to 60° beginning at 19'6" - dense - saturated.

22'3"-23'2" - Sandy fibrous debris, trace to some shells & shell fragments, trace coal, decayed wood.

23'2"-24'10" - Fine sand, trace to some shells and shell fragments - 1/4" clay layer at 23'7" - dark gray 1/4" stratification lines 24'0" to 24'10", light to dark gray - dense - saturated.

End of Boring

NOTES:

Sample obtained using 3 in. X 10 ft. shelby tube - recovery 70%.
Top 4' of sample (17'10" to 20'10") composited for chemical testing after removal of 1/8" to 1/4" of the surface layer.